Redescription of *Hippolyte ventricosa* H. Milne Edwards, 1837 based on syntypes, with remarks on *Hippolyte orientalis* Heller, 1862 (Crustacea, Decapoda, Caridea)

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Udekem d'Acoz d' C. 1999. — Redescription of *Hippolyte ventricosa* H. Milne Edwards, 1837 based on syntypes, with remarks on *Hippolyte orientalis* Heller, 1862 (Crustacea, Decapoda, Caridea). *Zoosystema* 21 (1) : 65-76.

KEY WORDS
Hippolyte ventricosa,
Hippolyte orientalis,
Hippolyte proteus,
Crustacea,
Decapoda,
Caridea,
Hippolytidae,
Indo-Pacific,
India,
Red Sea,
Gulf of Aden,
taxonomy,
syntypes.

ABSTRACT
The shrimp *Hippolyte ventricosa* H. Milne Edwards, 1837 is redescribed in detail, largely on the basis of syntypes. *H. ventricosa* has been previously recorded in various parts of the Indo-Pacific Ocean but most of these records are probably based on closely related species. For the time being, the true *H. ventricosa* is only known with certainty from India. Subtle but significant differences have been detected beween Indian *H. ventricosa* and its close relative from the Red Sea and the Gulf of Aden, *H. orientalis* Heller, 1862. These two species were previously considered as synonyms. A lectotype is designated for *Hippolyte proteus* (Paul'son, 1875).

MOTS CLÉS
Hippolyte ventricosa,
Hippolyte orientalis,
Hippolyte proteus,
Crustacea,
Decapoda,
Caridea,
Hippolytidae,
Indo-Pacifique,
Inde,
mer Rouge,
golfe d'Aden,
taxonomie,
syntypes.

RÉSUMÉ
Redescription de Hippolyte ventricosa *H. Milne Edwards, 1837 fondée sur les syntypes, avec des remarques sur* Hippolyte orientalis *Heller, 1862 (Crustacea, Decapoda, Caridea).*
La crevette *Hippolyte ventricosa* H. Milne Edwards, 1837 est redécrite en détail, essentiellement d'après les syntypes. *H. ventricosa* a été signalée en de nombreux points de l'Indo-Pacifique, mais la plupart des signalements antérieurs sont probablement fondés sur des espèces voisines. Pour l'instant, les seuls signalements certains de *H. ventricosa* concernent des spécimens récoltés en Inde. Des différences subtiles mais significatives ont été relevées entre des *H. ventricosa* originaires de l'Inde et sa proche parente de la mer Rouge et du golfe d'Aden, *H. orientalis* Heller, 1862. Ces deux espèces étaient précédemment considérées comme synonymes. Un lectotype est désigné pour *Hippolyte proteus* (Paul'son, 1875).

INTRODUCTION

The systematics of the Indo-Pacific species of the genus *Hippolyte* Leach, 1814 is chaotic (d'Udekem d'Acoz 1996). Many species are only known by very short and totally inadequate original descriptions. There are probably many undescribed species and several distinct species have been obviously lumped together under the name *Hippolyte ventricosa* H. Milne Edwards, 1837 that was previously considered as the commonest and most widespread Indo-Pacific species of the genus (Holthuis 1947; Chace 1997).

The original description of *Hippolyte ventricosa* (as *Hippolyte ventricosus*) by H. Milne Edwards (1837) is extremely short and imprecise: "*Espèce extrêmement voisine de l'H. variable* [*Hippolyte varians* Leach, 1814] *mais dont le rostre ne porte en dessus qu'une seule dent située près de sa base, et dont les prolongements latéraux des trois premiers anneaux de l'abdomen présentent des dimensions très considérables. Longueur, environ 4 lignes* [9 mm]. *Trouvée par M. Dussumier dans les mers d'Asie (C. M.).*" The real identity of H. Milne Edwards' species cannot be established from his description.

Fortunately the type material of the species still exists. Indeed, in the collections of the Muséum national d'Histoire naturelle (MNHN), Paris, I found an old vial with the following typed label: "*Hippolyte ventricosus* Edw., Inde, M. Dussumier." In my opinion these indications clearly demonstrate that the specimens are the syntypes of H. Milne Edwards' species, even if their morphology does not coincide perfectly with the original description. Although almost all walking legs are detached, the specimens are otherwise in a remarkably good condition after a conservation of almost two centuries in alcohol.

Hippolyte ventricosa H. Milne Edwards, 1837 is redescribed hereafter, largely on the basis of syntypes, and is compared with its close relative *Hippolyte orientalis* Heller, 1862 previously considered as a junior synonym of *H. ventricosa* (see Holthuis 1947; d'Udekem d'Acoz 1996; Chace 1997). This study is the first logical step towards a possible revision of the Indo-Pacific species of the genus *Hippolyte*.

The ratios have been calculated according to the method proposed by d'Udekem d'Acoz (1996).

ABBREVIATIONS

MNHN Muséum national d'Histoire naturelle, Paris;
P pereiopod.

SYSTEMATICS

Hippolyte ventricosa H. Milne Edwards, 1837 (Figs 1-4)

Hippolyte ventricosus H. Milne Edwards, 1837: 371. – Kemp 1914: 96, pl. 2, figs 1-3.
? *Hippolyte ventricosus* – Kemp 1916: 391 (no description except for colour pattern).
? *Hippolyte ventricosa* – Tirmizi & Kazmi 1984: 313, fig. 1a-g.
Hippolyte ventricosa – d'Udekem d'Acoz 1996: 108, 112, 115, in part.

MATERIAL EXAMINED. — **India.** M. Dussumier coll., 7 mature ♀♀ in alcohol, in fairly good condition (MNHN Na 1672) [obviously the syntypes of *H. ventricosa*], 1 specimen dissected with first and second maxilla, and first and second maxilliped on permanent microscopical preparation mounted with euparal. — Kilakarai Ramnad District, Tamilnadu, 13-25.II.1913, S. W. Kemp coll., Reg. No. 84 58/10, 1 ♂, 8 ♀♀, 1 juvenile (MNHN Na 4717) [specimens already reported by Kemp (1914)]. — Maharashtra, rocks of Ratnagiri, on brown algae of the genus *Padina*, 19.II.1980, P. Y. Noël coll., 4 ovigerous ♀♀ (MNHN Na 8140).

DESCRIPTION OF SYNTYPES (MATURE FEMALES)

Outline fairly robust (Fig. 1A). Ratio lateral length/height of carapace = 1.7-2.0. Rostrum fairly narrow to high, straight, rather long, slightly shorter or slightly longer than carapace; overreaching antennular peduncle; reaching at most scaphocerite apex. Rostrum without distinct mediolateral carina; two dorsal rostral teeth in proximal position in five specimens, one dorsal rostral tooth in proximal position in two specimens; no subdistal dorsal rostral tooth; no postrostral teeth; base of supraorbital tooth posterior to posterior orbital margin; tip of supraorbital tooth far from reaching the base of first dorsal tooth; one to four ventral teeth on the distal half of the rostrum (Figs 1A, 2A-F). Antennal tooth distinctly overreaching inferior orbital angle (Fig. 2B). Hepatic spine nearly reaching or slightly overreaching anterior edge of carapace.

Pterygostomian angle not strongly protruding (Fig. 1A).

Third pleonite moderately curved in lateral view (Fig. 1A). The slight angular discontinuity on dorsal border of fourth pleonite in the shrimp illustrated on Figure 1A is due to damage and is not present in other syntypes. Ratio dorsal length/height of the sixth pleonite = 1.5-1.9. Distal border of telson with eight strong spines; their length gradually increases from the sides to the center of the distal border of the telson; no intermediate spinules (Fig. 2H). First pair of

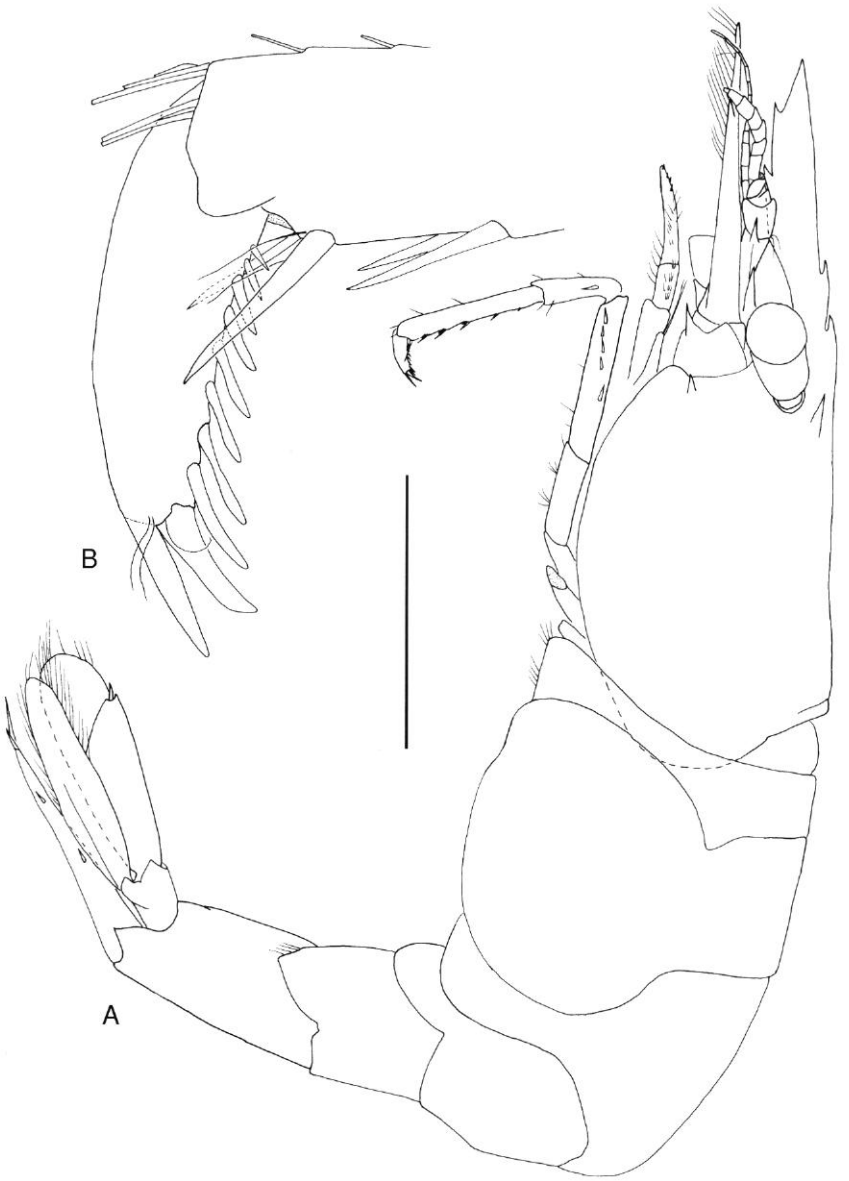

FIG. 1. — *Hippolyte ventricosa* H. Milne Edwards, India, syntype, ovigerous ♀; **A**, shrimp in lateral view ; **B**, dactylus of left third pereiopod. Scale bar: A, 2.0 mm ; B, 0.22 mm.

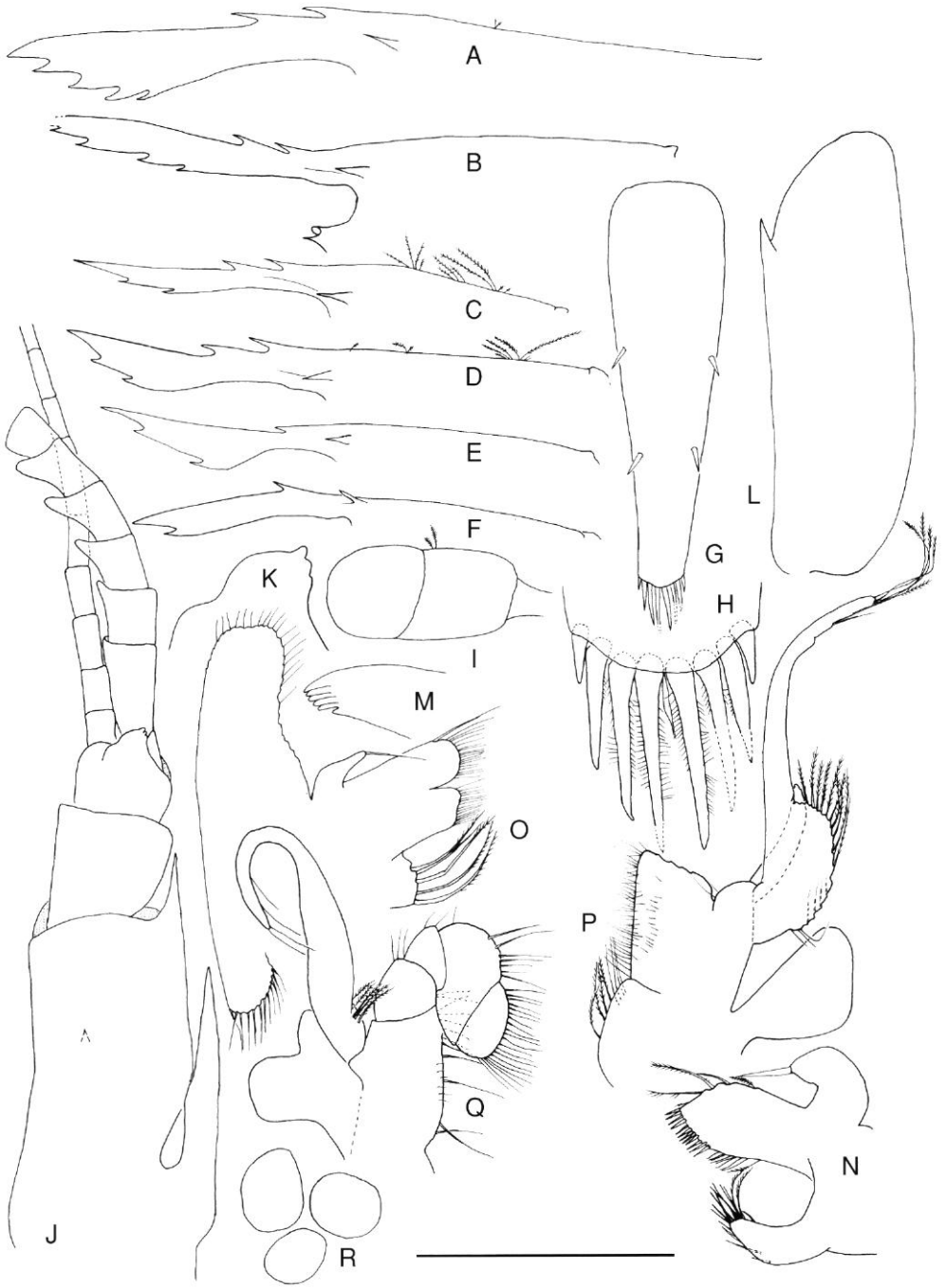

FIG. 2. — *Hippolyte ventricosa* H. Milne Edwards, India, syntypes, ♀♀; **A-F**, rostrum and dorsal part of carapace; **G**, telson; **H**, tip of telson; **I**, left eyestalk in dorsal view; **J**, right antennula; **K**, dorsal tip of third segment of right antennular peduncle; **L**, left scaphocerite; **M**, incisor process of left mandible; **N**, left first maxilla; **O**, right second maxilla; **P**, left first maxilliped; **Q**, right second maxilliped; **R**, eggs in early stage; the illustrated appendages belongs to the specimen with rostrum illustrated on Fig. 2B, except the eyestalk which belongs to the specimen of Fig. 1. Scale bar: A-G, 2.0 mm; I, L, R, 1.3 mm; J, N-Q, 0.68 mm; H, M, 0.34 mm; K, 0.22 mm.

dorsolateral spines between proximal third and middle of telson (Fig. 2G).

Unpigmented part of the eyestalk (measured dorsally from the point where it begins to broaden to the base of cornea) slightly longer than broad and slightly longer than cornea (Fig. 2I). Cornea overreaching or not reaching stylocerite apex. Antennular peduncle reaching 0.5 of scaphocerites. First segment of antennular peduncle with one distal outer tooth; inner ventral tooth on 0.65 of first segment of antennal peduncle (distal outer tooth not considered); stylocerite medium-sized, reaching 0.73 (distal tooth included), 0.87 (distal tooth excluded) of first segment of antennular peduncle in specimen dissected (Fig. 2J). Second segment of antennular peduncle 1.0-1.3 time as long as broad in dorsal view, approximately 1.5 time as long as third segment in dorsal view. Outer antennular flagellum shorter than inner. Scaphocerite 3.1 times as long as wide in specimen dissected; distolateral spine of scaphocerite far from reaching tip of blade; distolateral spine and blade separated by a distinct notch (Fig. 2L).

Mouthparts with morphology typical for the genus *Hippolyte* (Figs 2M-Q, 3A). Mandibular incisor process with six teeth (one mandible examined) (Fig. 2M). Second maxilla with upper margin of scaphognathite straight (Fig. 2O). Epipod of first maxilliped with outer margin straight (Fig. 2P). Epipod of second maxilliped with outer margin distinctly notched (Fig. 2Q). When extended forward, the third maxilliped reaches about 0.4-0.6 of the scaphocerite. Third maxilliped (Fig. 3A) with few rather short apical setae but with nine to eleven large conical spines on its apex and the distal third of its inner border (three specimens examined); its exopod reaches half of antepenultimate segment of endopod; ultimate segment nearly twice as long as penultimate (spines not considered).

Outer edges of fingers of P1 chela not denticulate (Fig. 3C); tip of fixed finger with three massive tooth-like spines; tip of dactylus with four massive tooth-like spines, one being bicuspid (two P1 examined) (Fig. 3B-D).

First segment of P2 carpus distinctly longer than third segment (Fig. 3E), 0.8-0.9 time as long as sum of second and third segments; first segment 2.8-3.8 times as long as wide, second segment 1.1-1.2 time as long as wide, third segment 1.6-2.0 times as long as wide (five P2 measured). Three distal teeth on P2 fixed finger (two bicuspid), four distal teeth on dactylus (two bicuspid), cutting edges not denticulate (one P2 examined) (Fig. 3F).

P3 to P5 long and rather robust, with few setae (Figs 1A, 3G-I). Extended forward, only previously undetached P3 almost reaching scaphocerite apex; with merus 6.1 times as long as wide, carpus 3.8 times as long as wide, propodus 6.9 times as long as wide; merus with five lateral outer spines, carpus with one proximal outer spine, propodus with six pairs of ventral spines of normal length and robustness, dactylus with ten spines (Fig. 1A-B). Detached P3-P5 with zero to six lateral outer spines on merus, one proximal spine on carpus (two spines on one carpus), five to seven pairs of ventral spines on propodus, eight to fourteen spines on dactylus (sixteen P3-P5 examined). Dactylus of normal breadth and length; spines all in one row, in ventral and apical positions (none in dorsal or subdorsal positions); two apical spines; ventral and apical spines of normal length and width (Fig. 1B); ultimate spine apparently partly fused to dactylus (junction of ultimate spine and dactylus difficult to see on microscopical preparations); ultimate spine of P3 dactylus longer than penultimate spine. Ratio length of ultimate spine of P3 dactylus/length of penultimate spine: 1.2. Ratio length of P3 dactylus with longest apical spine/length of propodus: 0.40. Ratio length of P3 dactylus with longest apical spine/length of carpus: 0.65. Ratio length of dactylus without spines/breadth of dactylus without spines: 3.0. Ratio length of dactylus with largest apical spine/breadth of dactylus without spines: 3.9. Ratio length of longest spine of P3 dactylus/breadth of dactylus without spines: 1.1. These ratios have been measured on the only P3 that was still attached. The variability of these ratios in detached P3-P5 is slight.

Most specimens (including all syntypes) with fascigerous setae on their ocular peduncles and often on their body. Number of fascigerous setae very variable.

Eggs small, 0.32-0.44 mm when recently extruded (Fig. 2R).

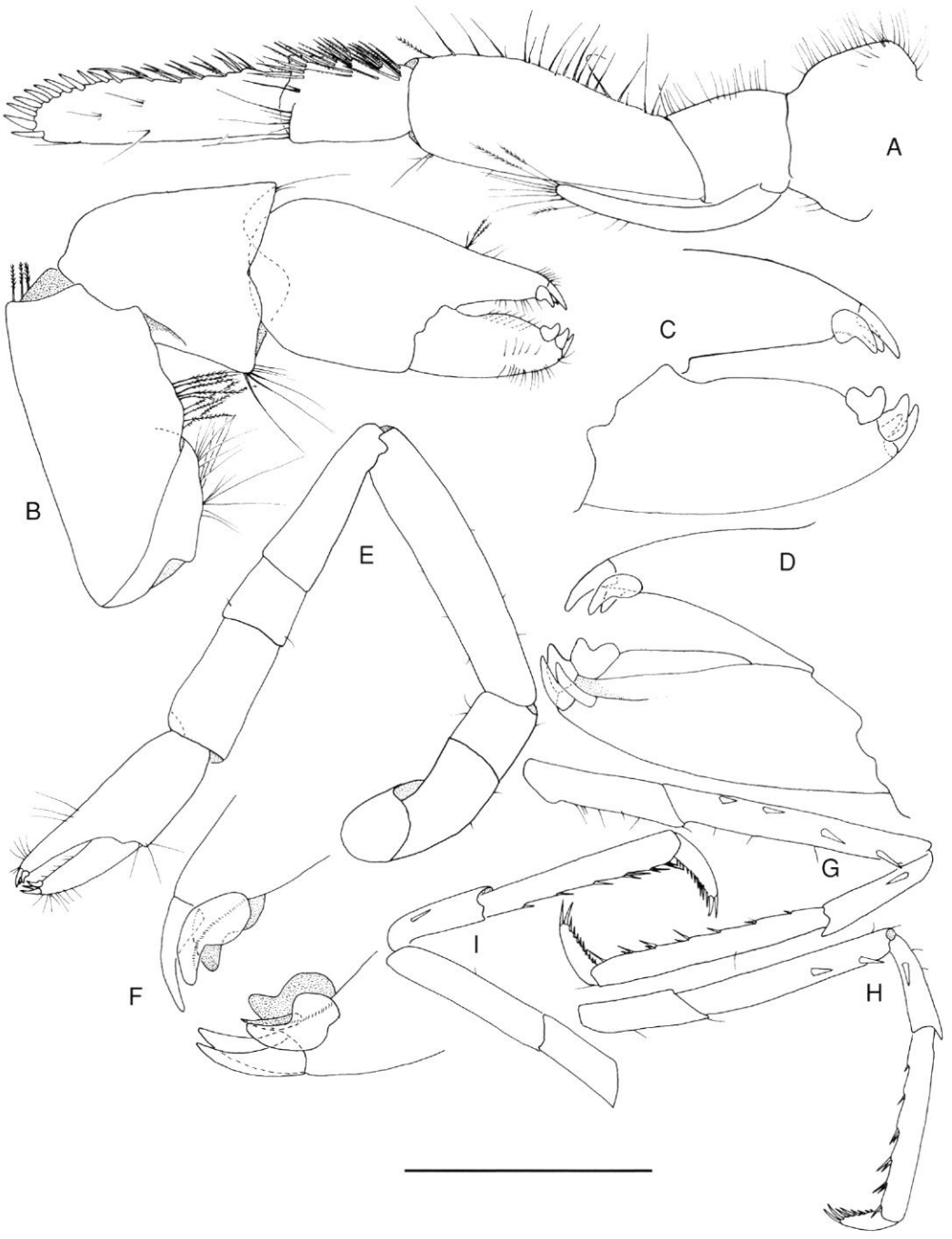

FIG. 3. — *Hippolyte ventricosa* H. Milne Edwards, India, syntypes, ♀♀; **A**, left third maxilliped; **B**, right first pereiopod; **C**, chela of right first pereiopod in outer view (setae not shown); **D**, the same in mesial view; **E**, left second pereiopod; **F**, tip of the chela of left second pereiopod (setae not shown); **G**, probably third right pereiopod; **H**, probably fourth right pereiopod; **I**, probably fifth right pereiopod; all appendages previously detached, except third maxilliped which belongs to the specimen with rostrum illustrated on Fig. 2B. Scale bar: A, B, E, 0.68 mm; C, D, 0.34 mm; G, H, I, 1.3 mm; F, 0.10 mm.

ADDITIONAL DESCRIPTIVE CHARACTERS BASED ON NON-SYNTYPE SPECIMENS

Kemp's and Noël's Indian specimens show no significant differences with the syntypes. However most pereiopods are still attached in Noël's specimens, and one male is present in Kemp's material.

In Noël's specimens there are three to five spines on P3 merus, zero to two spines on P4 merus, no spines on P5 merus. The second pleopods of Kemp's male were no longer attached. However, I found the endopodite of a male pleopod in the vial containing Kemp's specimens, obviously the endopodite of the male present in the vial. On this endopodite, the appendix masculina has eleven apical setae and it is much shorter than the appendix interna (Fig. 4A). The P1 of two Kemp's specimens have been examined on high magnification (× 250) and they have the same ornamentation as syntypes. A detached male walking leg was found in the vial containing Kemp's specimens (Fig. 4B-C): it showed no significant morphological differences with females, except the propodal dilatation (that is observed in the males of most *Hippolyte* species).

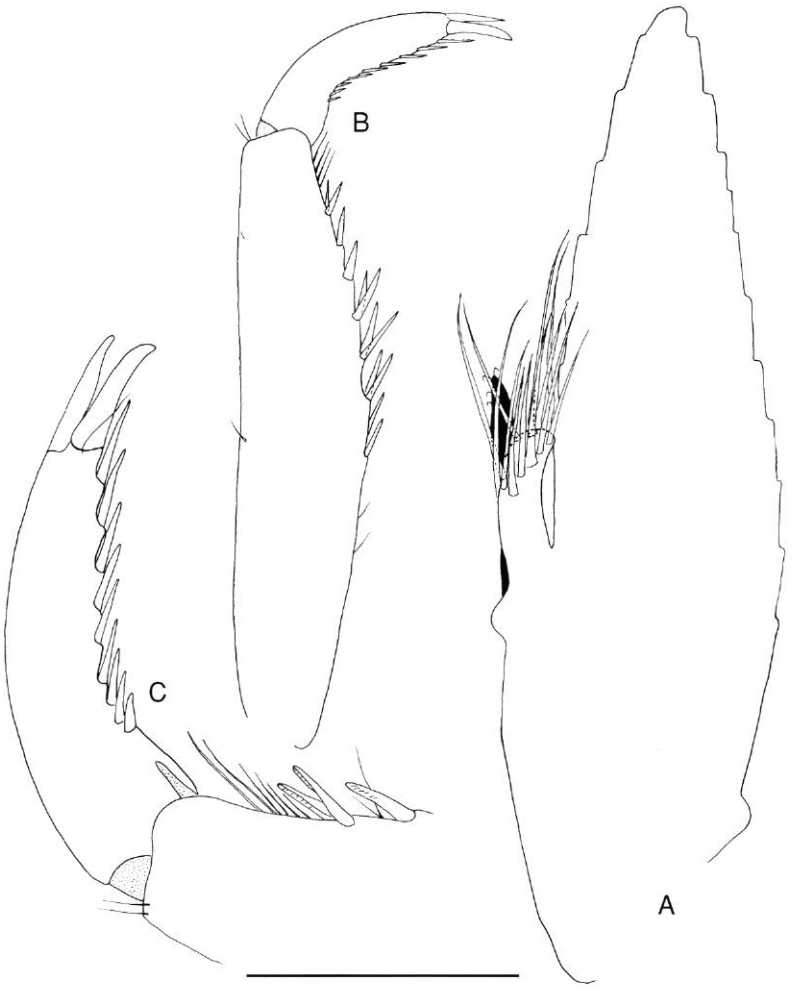

FIG. 4. — *Hippolyte ventricosa* H. Milne Edwards, India, Kilakarai Ramnad District, Tamilnadu, ♂; **A**, detached second pleopod; **B**, propodus of a detached walking leg (probably third pereiopod); **C**, dactylus of the same. Scale bar: A, C, 0.22 mm; B, 0.43 mm.

COLOUR PATTERN
"In colour the majority were of a brilliant green; but many other types [...] were observed" (Kemp 1914). If the Kemp's (1916) specimens are correctly identified, *H. ventricosa* can also be dull olive brown.

MEASUREMENTS
Total length of syntypes up to 17 mm. If Kemp's (1916) specimens are correctly identified, the species can reach up to 21 mm.

ETYMOLOGY AND SPELLING
There are two spelling mistakes in the name proposed by H. Milne Edwards (1837), *Hippolyte ventricosus*. Indeed the correct Latin spelling of the species name is "*ventriosus*" (= big-bellied) and not "*ventricosus.*" However, the International Code of Zoological Nomenclature (third edition), art. 32 states that in case of incorrect latinization, the original spelling should be maintained. On the other hand the specific name "*ventricosus*" being an adjective, it should be in concord with the genus *Hippolyte* which is feminine. So the species should be named *Hippolyte ventricosa*.

TYPE SERIES
Since the type series seems morphologically homogenous and since most pereiopods are detached and mixed together, I think that it is preferable to designate no lectotype for the time being.

ECOLOGY
"Living among *Zostera* and other weeds inside the coral reef at depths ranging from low water to two fathoms" (Kemp 1914). If Kemp's (1916) specimens are correctly identified, *H. ventricosa* is also "living in fucoid weeds washed by the waves." Between rocks on brown algae of the genus *Padina* (material collected by P. Y. Noël).

GEOGRAPHICAL DISTRIBUTION AND REMARKS
Hippolyte ventricosa is only known with certainty from India. Specimens of Tirmizi & Kazmi (1984) probably belong to the same species: no morphological differences can be detected in their drawings (which are insufficiently detailed) and they were collected in Pakistan, *i.e.* very close to India. Hilgendorf's (1878) *Virbius mossambicus* Hilgendorf, 1878, Barnard's (1950) and Kensley's (1972) *Hippolyte ventricosa* H. Milne Edwards, 1837 from African coasts of Indian Ocean are perhaps true *H. ventricosa* but it is not at all sure. Indeed, the figures of these authors are insufficiently detailed to identify their material. Most other Indo-Pacific records are probably based on other species. Indeed, in many instances significant differences can be detected in published accounts, particularly as concerns the shape and the proportions of scaphocerites, and the length and position of spines on dactylus of P3-P5 (d'Udekem d'Acoz 1996). Furthermore, the observations of Ledoyer (1984) suggests that some Indo-Pacific *Hippolyte* species could have a limited range of geographical distribution and are replaced in different parts of this ocean by vicariant species.
It is premature to propose a key, even preliminary, of the Indo-Pacific *Hippolyte*.

Hippolyte orientalis Heller, 1862
(Fig. 5)

Hippolyte orientalis Heller, 1862: 277.
Virbius proteus Paul'son, 1875: 115, in part: pl. XVI, figs 3(?), 3a, 3b, 3c(?), 3d(?), 3f(?), 5a, 5b, not pl. XVI fig. 4, not pl. XVIII fig. 1 [= *Hippolyte proteus* (Paul'son, 1875)].
Virbius orientalis – Nobili 1906: 33, in part.
Hippolyte ventricosus – Gurney 1927: 391, figs 94, 95; 1936: 25 – Kremer 1990: 34, figs 15-21 (not published).
Hippolyte ventricosa – Holthuis 1947: 55, in part, Red Sea material only, not figs 7-9 (= ? new species); 1958: 33 – d'Udekem d'Acoz 1996: 108, 112, 115, in part.

MATERIAL EXAMINED. — Gulf of Aden, Djibouti, H. Coutière coll., 109-97, G. Nobili det., 1905, half a dozen badly mutilated specimens and fragments previously mixed together with *Hippolyte proteus* (Paul'son, 1875) (MNHN Na1600).

SYSTEMATIC POSITION
Hippolyte orientalis was originally described from the Red Sea by Heller (1862). Although without illustrations, the original description is rather good and definitely indicates that it is an *Hippolyte* of the group *ventricosa*. Indeed Heller (1862) indicates that the first segment of anten-

nular peduncle has a distal outer tooth. The type material of *Hippolyte orientalis* has probably been deposited in the Naturhistorisches Museum, Wien and there are good reasons to believe that it is still extant. Indeed the type material of two other *Hippolyte* species described by Heller still exists in this museum: *Hippolyte leptocerus* (Heller, 1863) (d'Udekem d'Acoz 1996) and *Hippolyte gracilis* (Heller, 1862) (Dworschak *in lit.*).

After its original description, *H. orientalis* was recorded in the Red Sea by several carcinologists, under various names. On the other hand it can be assumed that Gurney's (1927) "*Hippolyte ventricosa*" from the Suez Canal are also *H. orientalis* since they come from areas very close to the Red Sea and agree quite well with Heller's description.

H. orientalis was previously considered by all modern authors, including me, as a junior syno-

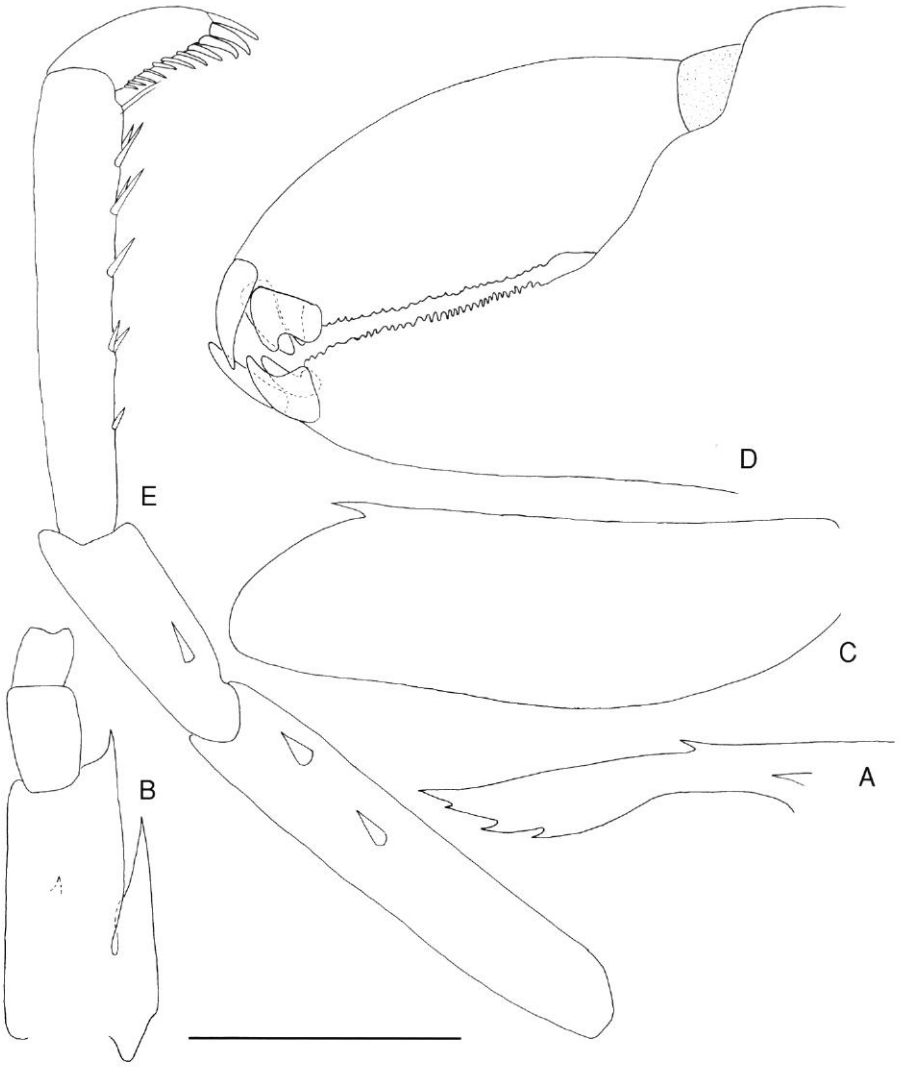

FIG. 5. — *Hippolyte orientalis* Heller, Gulf of Aden, Djibouti, ♀♀; **A**, rostrum; **B**, right antennular peduncle; **C**, right scaphocerite; **D**, chela of right first pereiopod; **E**, third right pereiopod. Scale bar: A, B, C, 1.3 mm; E, 0.68 mm; D, 0.22 mm.

nym of *H. ventricosa*. However, I now consider that both species are probably distinct.

I have reexamined the specimens from Djibouti (Gulf of Aden) reported as *Virbius orientalis* by Nobili (1906) which are housed in the Muséum national d'Histoire naturelle, Paris. Nobili's specimens which are in an extremely bad condition prove to be a mixture of *Hippolyte proteus* (Paul'son, 1875) and of an *Hippolyte* of the group *ventricosa*, a fact that was already suggested by Nobili's (1906) account. Due to the close proximity between the Red Sea and the Gulf of Aden and the biogeographical similarity of these two areas, it is most likely that the Nobili's *Hippolyte* of the group *ventricosa* are *H. orientalis*. Therefore, they are here considered as such.

In the *H. orientalis* examined, the outer edges of the fingers of the P1 chela are minutely but distinctly denticulate (two P1 examined) while they are totally smooth in *H. ventricosa* (four P1 examined: two of syntypes and two of a non-type specimens). The denticulation of the first chela of *H. orientalis* was already pointed out by Kremer (1990) who said: "*Innenseiten der Scherenfinger mit kleinen Zähnen besetzt.*" In the limited material that I have examined, the number of spines on the merus of P3 in *H. orientalis* is always two, *i.e.* lower than in *H. ventricosa*. This fact is also supported by the written account of Gurney (1936) and by a figure of Kremer (1990) [who both used the name *H. ventricosa* for *H. orientalis*]. In all other respects (including ratio length/width of sixth pleonite and the number of apical telson spines), *H. ventricosa* and *H. orientalis* are nearly identical.

The number of meral spines has often an important systematic value in the genus *Hippolyte* although it is known to show slight geographical variations in some species (d'Udekem d'Acoz 1996, 1997). So, the importance of this last character taken alone should be considered with some reserve. On the other hand, there is little doubt that the difference in the ornamentation of the P1 chela is of specific nature. Therefore *H. ventricosa* and *H. orientalis* are here considered as distinct species.

Unfortunately, the extremely poor condition of Nobili's material and the small number of available specimens does not allow a more detailed study. According to Kremer (1990), adult *H. orientalis* have one to three dorsal rostral teeth and one to five ventral rostral teeth (dorsal and ventral teeth can be lacking in juveniles), five to eight teeth on incisor mandibular process, an appendix masculina with eight apical setae and much shorter than the appendix interna.

Geographical distribution

The geographical distribution of *H. orientalis* cannot be delimited with precision. However, it seems probable that it is not very wide. The species is known to occur in the Red Sea, the Suez Canal and the Gulf of Aden, and in my opinion it is not impossible that it also occurs in the Persian Gulf. This area is well-known for comprising several endemic species and subspecies, often closely related to typical Indo-Pacific forms (Por & Dimentman 1989).

Remarks

The original description of *Hippolyte proteus* (Paul'son, 1875) is obviously based on two species: *Hippolyte orientalis* Heller, 1862 and the species which is usually named *Hippolyte proteus* in literature. To my knowledge nothing is known as concerns Paul'son's material but it can be assumed that it is probably lost. In order to preserve the stability of nomenclature I designate the specimen of figure 1 of Paul'son's (1875) plate 18 as the lectotype of *Hippolyte proteus*. This illustration shows all the characteristics of the species usually named *Hippolyte proteus*, including the absence of distal outer tooth on the first segment of antennular peduncle.

FURTHER RESEARCHES

Our knowledge of Indo-Pacific *Hippolyte* will probably progress rather slowly. The next logical step should be the detailed redescription of other imperfectly known species. This would be absolutely necessary for the species originally described as *Virbius australiensis* by Stimpson (1860) and its supposed synonym *Caradina cincinnuli* Bate, 1863. Indeed this or these species are only known by a quite rudimentary diagnosis and are

likely to be common in some tropical part of the Indo-Pacific Ocean. If all the type material of *Virbius autraliensis* is lost (which is probably the case), it would be necessary to designate a neotype for it. After the study of Stimpson's and Bate's species it will probably be possible to describe several new species. However they will be fairly difficult to describe correctly, some essential characters requiring examination under very high magnifications (for example, the teeth of the chelae). In any case, "preliminary", superficial, imprecise or short descriptions of new species should now be definitely banned.

Acknowledgements

I am very grateful to Dr N. Ngoc Ho (MNHN) for the loan of all the material studied in the present paper and for giving me the authorization to dissect one syntype of *Hippolyte ventricosa* H. Milne Edwards, 1837.

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Submitted on 7 January 1998;
accepted on 13 May 1998.